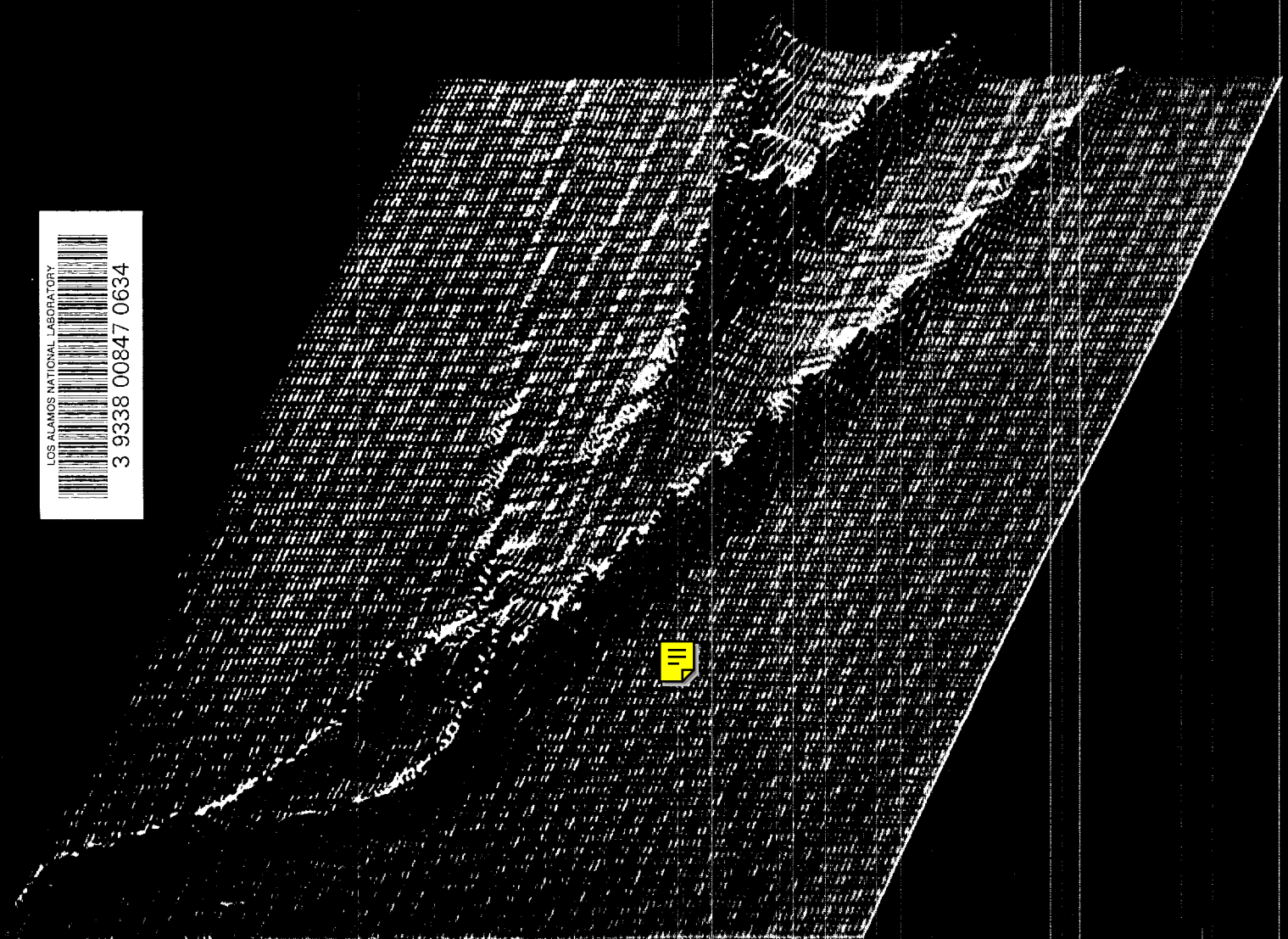
THE ATOM

Los Alamos Scientific Laboratory

June, 1971



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THE ATOM

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CONTENTS:

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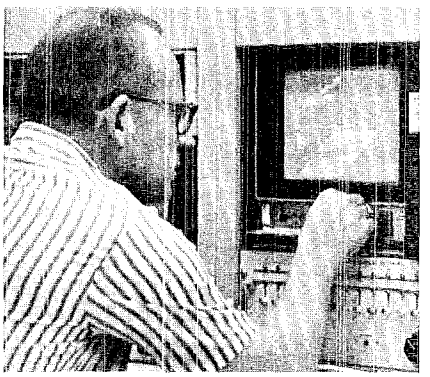
LAMPF Mountain Ranges and Bright Stars



Don Swenson, MP-3, observes an image recorded on the oscilloscope screen by the small computer. Beam quality has been checked and compared with design calculations by this method from the Cockcroft-Walton voltage source through the first tank of the drift-tube section of the accelerator.

Photos continue on next page

Raw diagnostic data is generally of little interest to anyone other than the scientists assigned to its collection and interpretation. Blips and scrambled lines don't mean much to the untrained eye.

At the Los Alamos Meson Physics Facility, however, diagnosticians are gaining valuable information about LAMPF accelerator beam properties that would look pretty good on your living room wall.

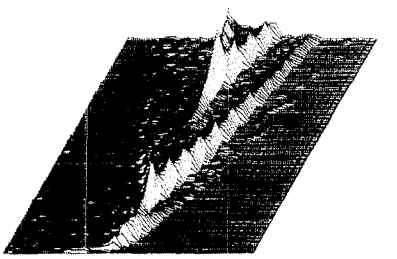
Computer-generated dimensional displays of the beam's properties produced on an oscilloscope screen look surprisingly like mountain ranges. Another display, seen on an aluminum-oxide viewing screen could well be taken for a bright star.

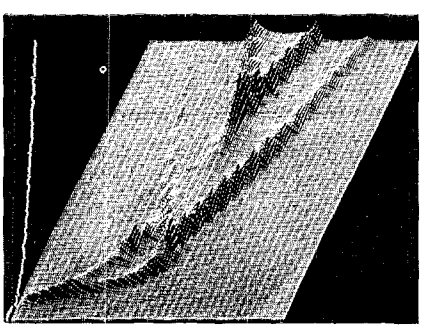
Purpose of the measurements is to perfect the performance of the beam and accelerator components and to compare these measurements against computer calculations used in the design of the accelerator.

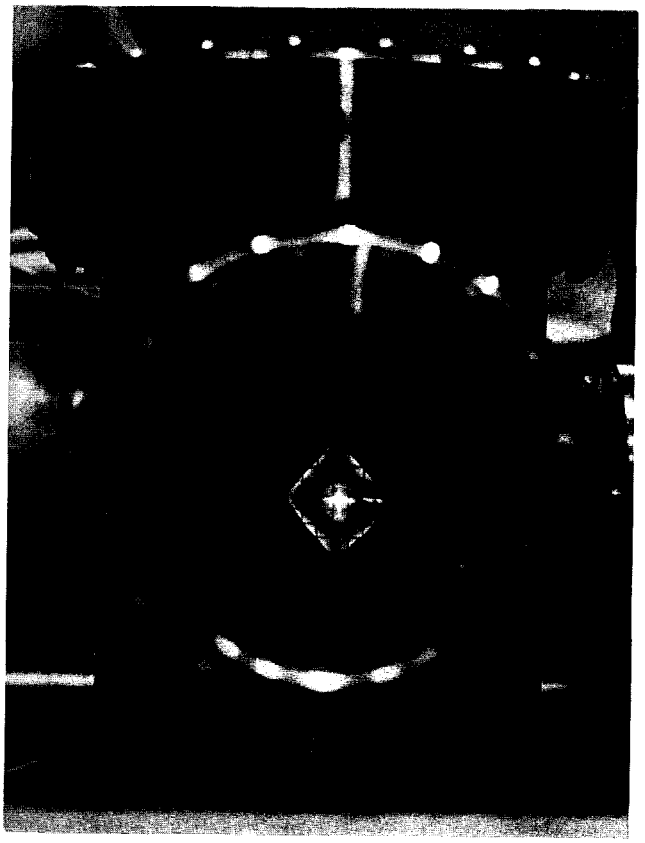
Measurements have been made of the Cockcroft-Walton voltage source, the proton ion source, the accelerating column, the low-energy beam transport system, the double buncher system and the first tank of the accelerator's drift-tube section. Measurements will continue to follow installation of accelerator components section by section right up to its 800 MeV end.

"It's an exciting and unique opportunity to check on the validity of calculations on which the accelerator's design was based," said Don Swenson of MP-3. "We're quite pleased with the results. The measurements come very close to matching our calculations."

These two photographs illustrate how close the beam energy spectra from the first tank of the drift-tube section of the LAMPF accelerator match with computer calculations on which accelerator design was based. The illustration at bottom is a composite of 150 measurements of the energy spectra of the beam for different levels of radio-frequency excitation. A small computer changes the radio-frequency level, measures the energy spectra and plots the entire graph in about 10 seconds. The illustration at top is a similar display based on calculated energy spectra. The most notable difference between the measured and the calculated spectra lies in the region of low radio-frequency excitation at the lower part of the illustration. This region is not likely to be used by LAMPF scientists.

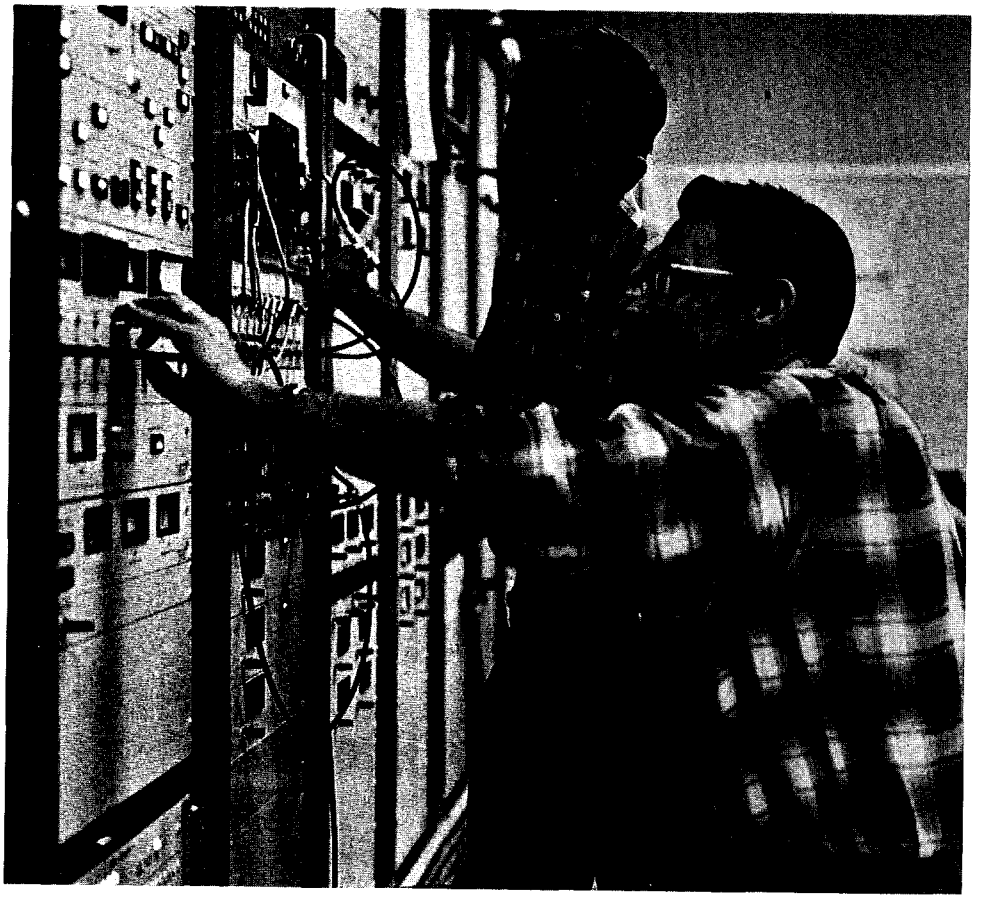




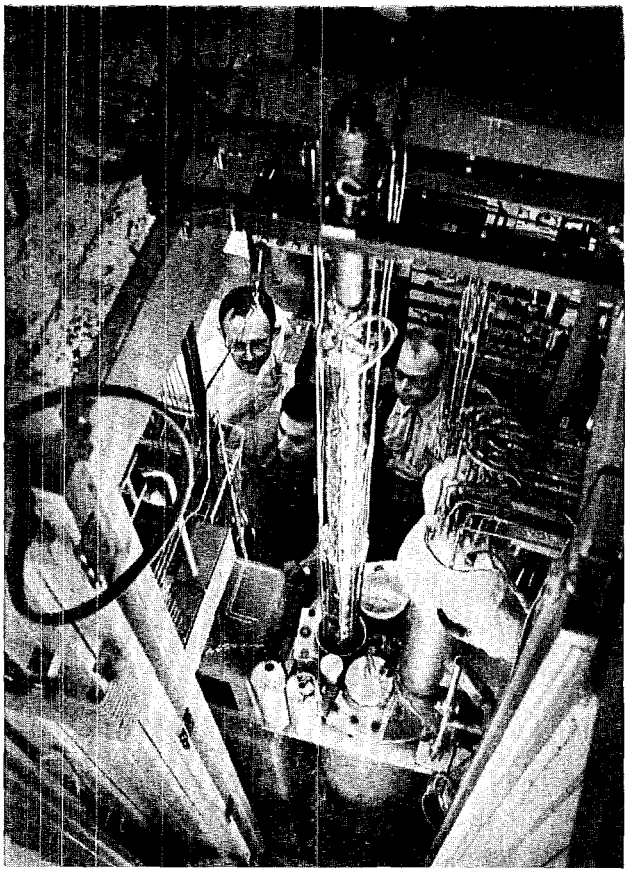


Through a porthole in the first section of the low-energy transport system can be seen a head-on view of the beam as it is extracted from the Cockcroft-Walton voltage source. An aluminum-oxide screen is placed in the beam line. When the beam strikes the screen, its energy is converted to visible light which indicates the size of the beam at this point.

Ralph Stevens, MP-4, and Mike Paciotti, MP-3, tune the beam in the first tank of the drift-tube section of the LAMPF accelerator. The effects of tuning are recorded on the oscilloscope screen by the small computer.



Another ICONS distillation tower is being installed by CNC-4. At the base of the new column are Robert Potter, ICONS section leader, Charles Lehman, and B. B. McInteer, alternate group leader.



Carbon-13:

a new clinical and environmental tool?

Scientists are looking toward a small group of rare isotopes as useful tools in both medicine and environmental control. These isotopes are becoming generally known as the ICONS, the acronym coined by Perry Stout of the University of California's Davis Campus for Isotopes of Carbon, Oxygen, Nitrogen and Sulfur.

The ICONS have never been available in large enough quantities for large-scale research and development programs, their costs in limited quantities were too high for either science or society to afford, and instrumentation was not available to carry out refined studies which are now possible.

Recent recognition that the ICONS could be used to perform important functions for society, however, has catalyzed technological advancements and scientists are now tooling up their proving grounds to put this technology to work.

Medical and environmental uses of the ICONS hinge to a large degree on the Los Alamos Scientific Laboratory. The Laboratory is one of the world's largest producers of the ICONS, with the exception of sulfur, and is currently conducting a series of research and development projects with carbon-13 and other isotopes that will have important bearing on other ICONS programs.

At present the Laboratory's major interest is a program funded by the Atomic Energy Commission's Division of Biology and Medicine to develop carbon-13 as a clinical tool that can be used to detect and identify certain diseases and other body disorders. Several environmental programs are also either underway or are in the planning stages.

The Laboratory's carbon-13 project began about three years ago. The Division of Biology and Medicine felt the isotope would be used widely in medical, biological and chemical research if it were made available in larger quantities and at reduced cost. At the time, the isotope, at various levels of enrichment, generally up to 60 per cent, was selling for as high as $3,000 a gram.

At the DBM's request LASL accelerated its plans to build carbon-13 production facilities and the division later funded a program at the Laboratory to enhance production of the isotope, develop detection techniques, and to conduct studies to assure clinicians that the isotope would not be toxic when used in human systems.

Scientists don't expect carbon-13 to have any toxic effects and studies to date confirm this be-

continued on page 5

In the ICONS control room are Joe Montoya and CNC-4 Group Leader Eugene Robinson.

lief. The isotope is a non-radioactive (stable) constituent of our environment. It is a heavy isotope of carbon which makes up 1.1 per cent of all naturally occurring carbon. Because it is a stable isotope which occurs in nature it is not expected to be harmful to either man or his environment. Because it does not make up a large part of our environment, small but highly concentrated amounts of it can be easily detected in any system whose makeup is governed by nature. This is because abnormally high concentrations of the isotope stand out above the natural background of the system in which it is used.

The carbon-13 project at Los Alamos is a joint venture between Groups CNC-4, headed by Eugene Robinson, and H-4, led by Wright Langham. CNC-4 is responsible for the production of the isotope and the development of sensitive detection techniques. In the development of these techniques the group uses carbon-13-labeled chemical and biochemical compounds prepared by H-4 which is also responsible for conducting the toxicity studies.

CNC-4 produces about seven kilograms of 90 to 95 per cent enriched carbon-13 a year. It is produced in a pair of unique and sophisticated fractional distillation towers. By normal design a carbon-13 distillation tower would be from 250 to 300 feet long and would be contained in a tall and expensive tower structure. This expense was greatly reduced by first building a 140-foot column in which a portion of its distillation activities function side by side, and then housing it in a hole in the ground.

Volume production by CNC-4 has reduced the isotope's cost by a factor of 100, or to about $30 a gram to date. With the exception of one kilogram of carbon-13 which is sent annually to the Mound Laboratory, the Atomic Energy Commission's isotopes distributor, for sale to other researchers, most of it is being used by H-4. According to Donald Ott, H-4 alternate group leader, the isotope is presently being used primarily in the toxicity studies being conducted for the Division of Biology and Medicine. Smaller amounts are used in labeling compounds for chemical and biochemical studies and the development of detection techniques.

The toxicity studies are being conducted by H-4 on mice, which are often referred to as "heavy" mice because carbon-13 is a heavy isotope of carbon. Since Feb. 1 two mice have been on a diet of yeast whose carbon content is about 90 per cent carbon-13. Although H-4 reports the rodents are not suffering from any apparent toxic effects, the program will be expanded to provide better statistical assurance. H-4 plans eventually to increase the number of mice used in the program to 10.

Each mouse requires 1.2 grams of carbon-13 per day. To arrive at this amount however, scientists must put four grams of the isotope into the yeast-growing process. This is because nearly three grams are respired during the yeast-growing process in the form of carbon-13 dioxide.

The process requires two grams each of carbon-13 in the form of carbon monoxide and carbon dioxide. The yeast is prepared through a chain of chemical reactions which begins with the conversion of carbon-13 dioxide to methanol. The methanol is converted to acetic acid by reacting it with carbon-13 monoxide and a catalyst. The acetate is then purified and serves as the medium on which the yeast grows.

With the exception of the carbon-13 that is retained in the bodies of the mice almost all of the isotope used in preparing the yeast and that excreted by the rodents is recovered, recycled and used again.

The yeast is grown in a controlled environment where the respired carbon-13 dioxide can be captured and recycled. Recovery of the carbon-13 for recycling was made possible through the efforts of Group GMX-2 which developed molecular-sieve canisters for its collection. The group also built the apparatus for the synthesis of methanol in preparing the acetate medium.

The yeast is combined with vitamins, minerals and roughage in the form of a pellet about an inch in diameter. The pellets are fed to the mice which are contained in special metabolism cages. The cages are kept in a controlled environment so that urine, feces and exhaled carbon-13 dioxide can be studied for any possible isotope effects and to recover the carbon-13.

Until recently yeast was prepared in a pair of 12-liter fermentors. Now H-4 has installed a 200-liter fermentor which can also be used for growing algae and bacteria. Algae is the source of many compounds of interest to chemists and biochemists including amino acids, glucose, galactose, xylose and also lipids which can be converted to hydrocarbons and glycerol. Because algae grow by the photosynthetic process, water-cooled lamps with variable intensity have been built into the fermentor.

Some of the compounds isolated from the algae by H-4 are used by CNC-4 in the development of carbon-13 detection techniques. The instrumen-

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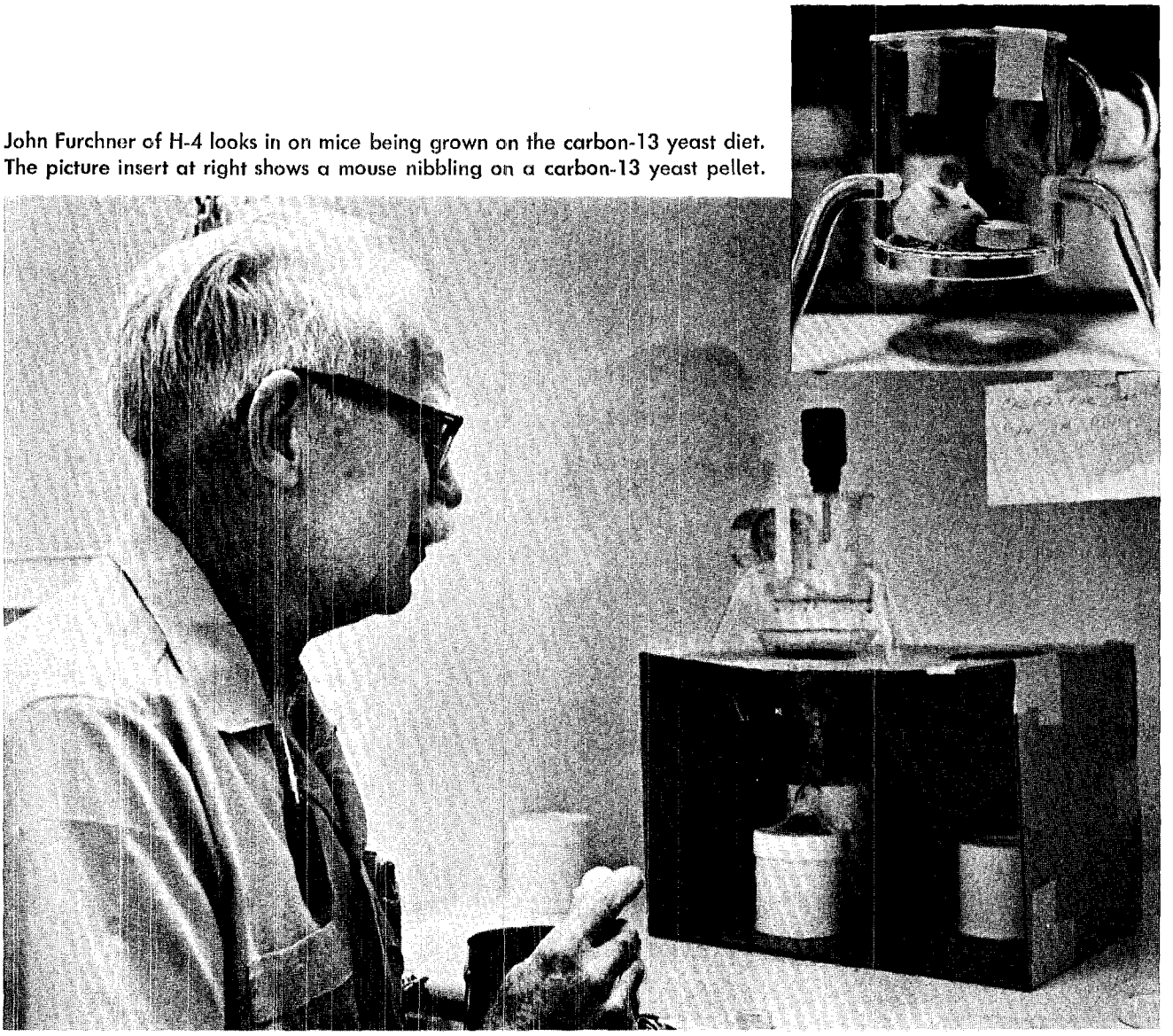
John Furchner of H-4 looks in on mice being grown on the carbon-13 yeast diet. The picture insert at right shows a mouse nibbling on a carbon-13 yeast pellet.



tation required to do refined analyses of complex carbon-13-labeled compounds has only recently been developed—namely carbon-13 nuclear magnetic resonance (NMR) spectrometers. Use of NMR techniques is dependent on an isotope having magnetic properties. Since carbon-13 and most of the other ICONS have these properties, NMR techniques are especially applicable to their study.

Another attractive feature of NMR is that each carbon-13 atom in a distinct chemical environment gives an equally distinct signal whose intensity is directly proportional to its concentration in that environment. This separation of signals in different chemical environments is usually so large that both quantitative and qualitative analytical techniques are possible in complex mixtures. The availability of instrumentation such as this makes carbon-13 and other ICONS attractive for use as "tracers" in both clinical and ecological systems, as well as in chemistry.

Group CNC-4 has installed some of the most sensitive and versatile NMR instrumentation available including two computer-operated spectrometers. A recent and ambitious achievement was CNC-4's attainment of the NMR spectrum of 90 per cent carbon-13-labeled chlorophyl. This is believed to be the first time the carbon-13 spectrum of a uniformly labeled natural product has been obtained. The objective of the study is to relate the NMR data to the biological function of the chlorophyl.

In addition to the toxicity studies and compound labeling there are innumerable other pos-

sible clinical and environmental applications for carbon-13 or other isotopes of the ICONS series.

One of the clinical applications thought to be possible with these isotopes is a glucose tolerance test for the early detection of diabetes. An experiment to verify the practicality of using carbon-13-labeled glucose in such tests has been proposed and would be conducted jointly by the Los Alamos Scientific Laboratory, Argonne National Laboratory and Brookhaven National Laboratory.

A conventional test for diabetes requires a patient to fast overnight before being given a carbonated glucose solution to drink. Blood samples are taken hourly for four to six hours and the rate of the disappearance of the glucose "load" is determined. With the exception of the glucose solution, the patient is denied food for 18 hours or more.

The tolerance test using carbon-13-labeled glucose would require a shorter period of fasting and would eliminate the necessity of taking blood samples. Instead of taking blood samples, the patient would, at intervals, breathe into a face mask designed for the collection of carbon-13 dioxide and the samples would be analyzed for carbon-13 content. The data collected would be used to distinguish between normal and diabetic handling of the labeled glucose.

It is also believed that similar tests could be used to detect inclination toward certain types of heart diseases and for screening newborns for a group of diseases which prevent them from properly metabolizing their foods.

Of the environmental applications thought possible with the ICONS, preliminary investigations have been started on one at Los Alamos. The investigations are being conducted by CNC-4 and H-8 personnel to determine how long carbon-13 and oxygen-18 carbon dioxide will persist in normal air. The idea behind the experiment is to see if the ICONS-labeled carbon dioxide will exist long enough for some micrometeorological measurements to be made and yet dissipate fast enough so as not to label local environments for long periods of time. One application might include using the labeled carbon dioxide to trace wind velocities and directions. Such information would be useful in the design and location of industrial facilities to prevent the migration of harmful waste products into populated areas. Dissipation rates of the ICONS would also be important in pinpointing sources of pollution. For example, if it were known that the air in a given city was being polluted by industrial wastes, po-

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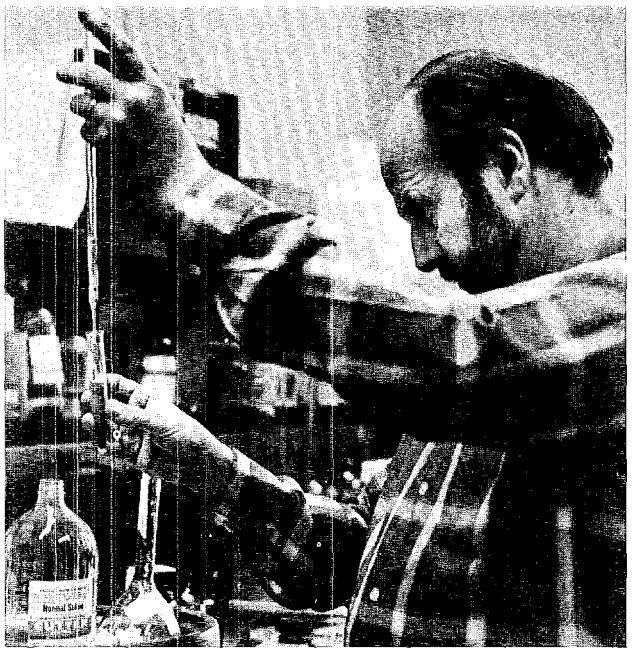
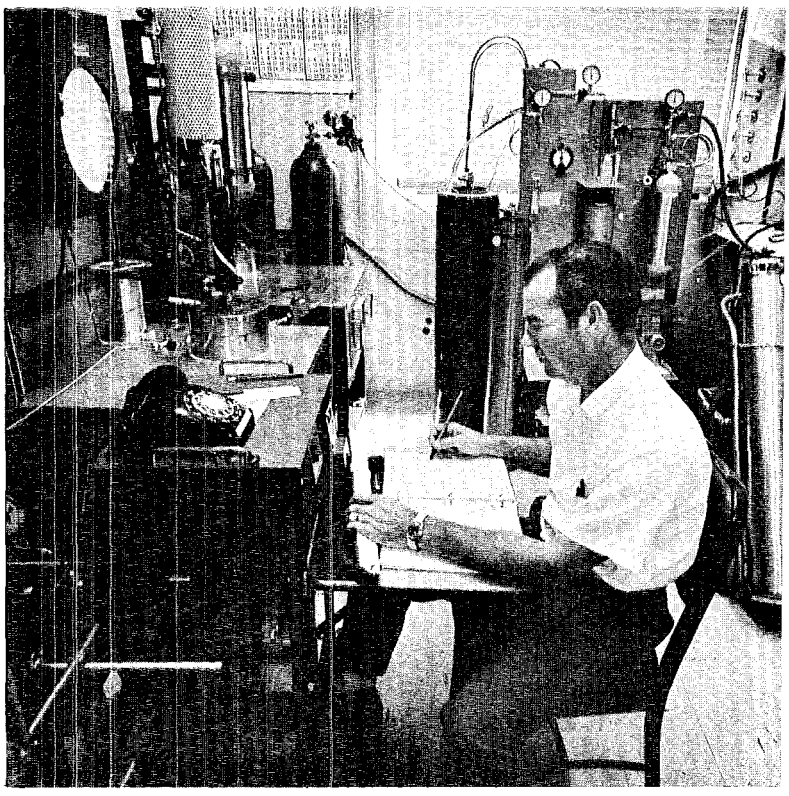


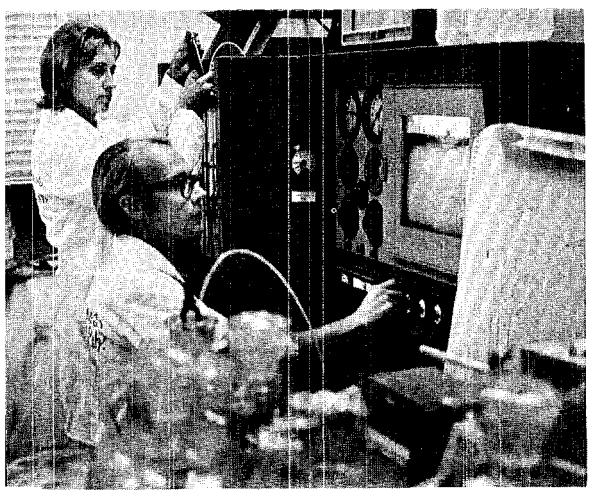
Charles Gregg, H-4, lables hemoglobin from the blood of mice with carbon-13. The structure of the hemoglobin will be studied with NMR spectrometers.

Donald Ott, H-4 alternate group leader, records data in the laboratory where acetate is made for carbon-13 yeast to grow on. Instrumentation in the background, including the molecular-sieve canisters were built by GMX-2.

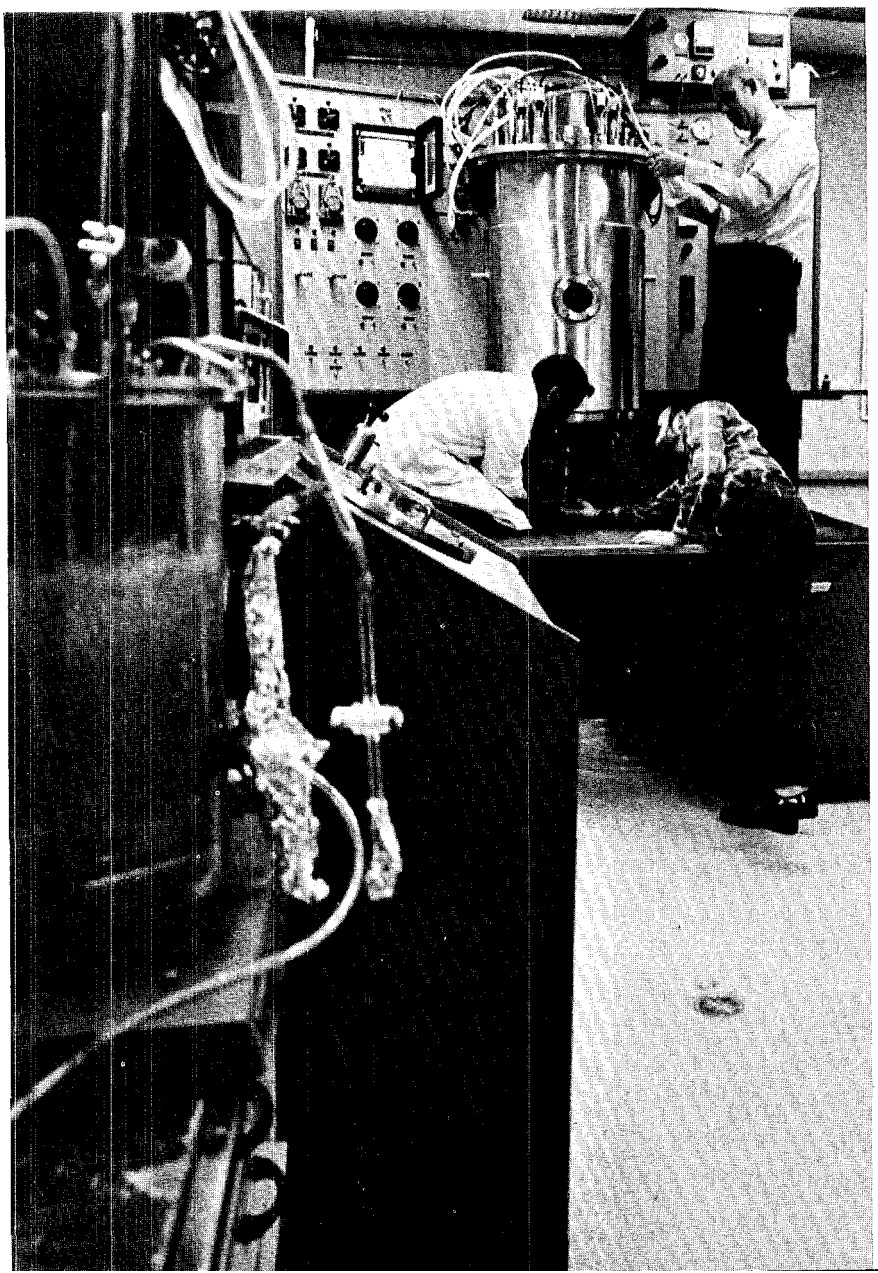


tential offenders might be singled out by labeling the industrial raw products with stable isotope such as carbon-13. Atmospheric emissions from these industrial installations would then also be carbon-13 labeled and would serve as an identifying mark for those responsible.

The possibilities for use of the ICONS in tracing and identifying sources of materials in medicine and our environment seem almost unlimited. In the near future, H-7 will attempt to grow "heavy" potatoes as a means of procuring carbon-13-labeled glucose. Most glucose used in medicine is derived from starches such as those contained in corn and potatoes. It has also been suggested that the ICONS will be useful in tracing the distribution of farmland fertilizers and pesticides, petroleum spills, the point of illicit diversion of barbituates, and water pollutants such as phosphates.



George Shepard and Billie Noland of H-4 record data from an apparatus used to make carbon-13 amino acids. These amino acids will be fed to mammalian cell cultures and are expected to make "heavy" histones (proteins) for genetic regulation and radiation effects studies.

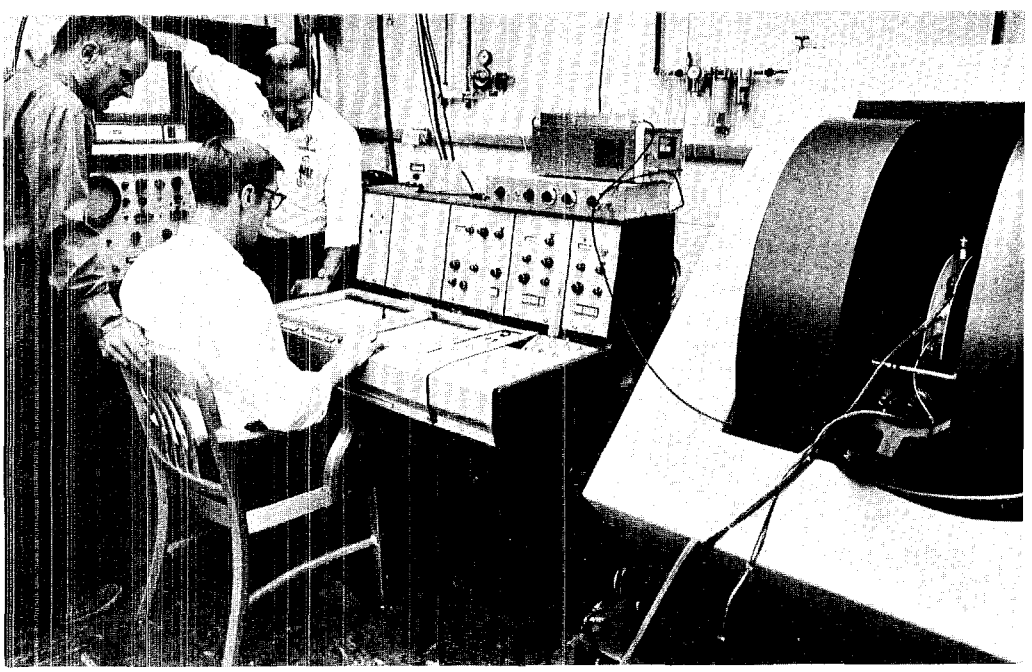


This 200-liter fermentor is used by H-4 to grow yeast, algae and bacteria for ICONS studies. Standing on the platform is Victor Coleman. Below Coleman are John Hanners and Gregg.

There is also expected to be an increasing need for the ICONS in fields where inroads have already been made. For example oxygen-16 has been used in combination with plutonium-238 in the SNAP (Systems for Nuclear Auxiliary Power) program initiated in 1955 to provide small amounts of electrical power in space. This plutonium-oxygen combination has a very low neutron background, a property which makes it ideal for use in SNAP, heart pump and heart pacer power sources. Oxygen-18 and nitrogen-15 are in high demand for use in heavy ion accelerators.

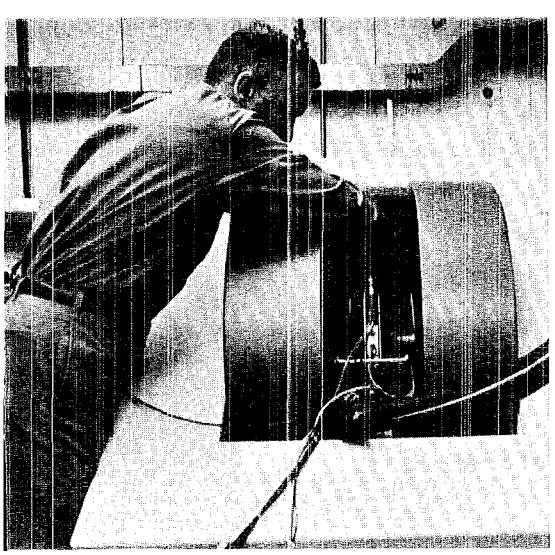
To keep pace with the increasing demands for the ICONS the Laboratory has long-range plans of bolstering its production facilities and to include isotopes of sulfur. Under these plans carbon-13 production would be increased an additional 10 kilograms per year. The new capability would produce 25 per cent enriched carbon-13 and would make larger quantities of the isotope available for public sale.

The First National Symposium on Carbon-13 will be held at Los Alamos June 9-11 to review progress in the applications of the isotope in chemistry and biochemistry. Those attending will also assess the possible applications of carbon-13 in chemistry, biology, ecology and clinical medicine. Because the ICONS have applications in common, the carbon-13 symposium is likely to have some bearing on other programs involving isotopes of the ICONS series.

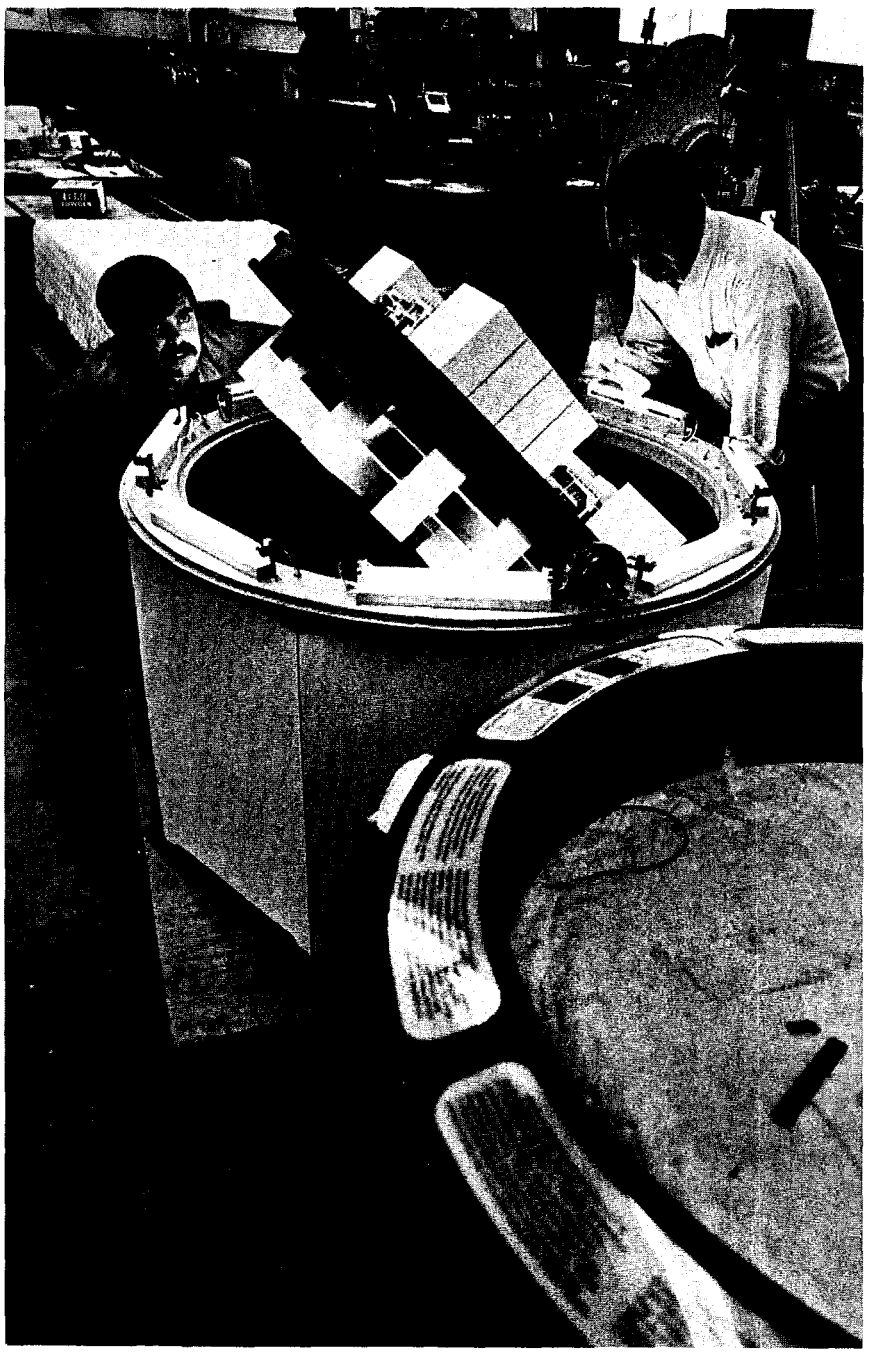


A chlorophyl sample is being studied with CNC-4's NMR instrumentation. The sample is in the holder at right. CNC-4's Nick Matwiyoff and Marty Reisfeld observe data being taken by U. S. Air Force Captain Don Shepard, seated, who is attached to the ICONS group.

Matwiyoff inserts a chlorophyl sample into a holder for NMR studies.



Scyllac Exhibit Being Prepared for Fourth Geneva Conference



Bruce Martinez and Mariano Vigil, both of the ENG-2 Model Shop, observe the rotation of the exhibit's top on which scale models of Scyllac are mounted back to back.

An exhibit featuring two scale models of Scyllac, the Los Alamos Scientific Laboratory's latest machine for research toward controlling a thermonuclear (fusion) reaction, is being readied for the Fourth International Conference on the Peaceful Uses of Atomic Energy Sept. 6-16 at Geneva, Switzerland.

The exhibit is being built at the ENG-2 Model Shop under the direction of John Mench. One of the models shows Scyllac as it will look when completed. The other shows the first of its three sectors—as it looks today.

The two models are mounted back to back on a rotating top. By pushing a button the top rotates and an information panel lights up. The panel lettering describes whichever model is exposed.

LASL will also have other exhibits at the Geneva Conference. These will include the Nuclear Safeguards Program; the Plowshare Program's Rulison experiment; the Shock Heated Toroidal Z-Pinch device which, like Scyllac, is being built for the Sherwood Program; and a model of the Los Alamos Meson Physics Facility featuring the accelerator's biomedical applications.

Two LASL scientists, MP-Division Leader Louis Rosen, and A-1 Group Leader G. Robert Keepin have been invited to give papers at the conference.

President of the Conference is Glenn Seaborg, chairman of the Atomic Energy Commission, who was appointed to the Geneva post by the United Nation's Secretary General U Thant.

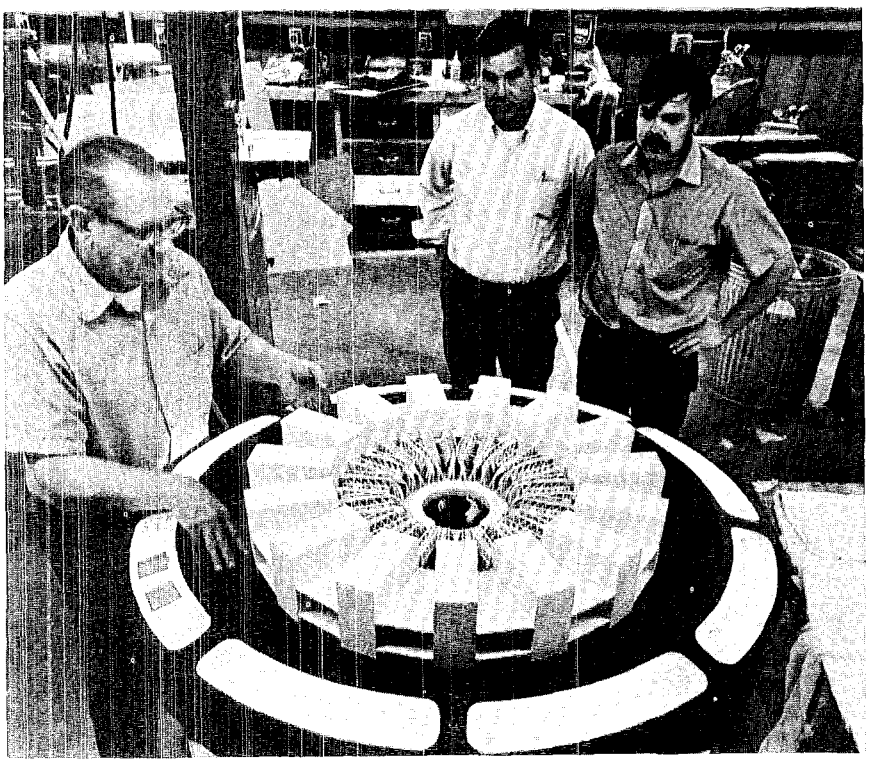
The international group's Gen-

John Mench, director of the ENG-2 Model Shop, works on the model of the first of Scyllac's three sectors.

eral Assembly has called for broader expert participation through a resolution which states: "Because of the growth in the practical applications of atomic energy and the importance of ensuring that such applications are made widely known, a conference whose agenda would concern public officials, economists, and planners, as well as technologists, would be desirable."

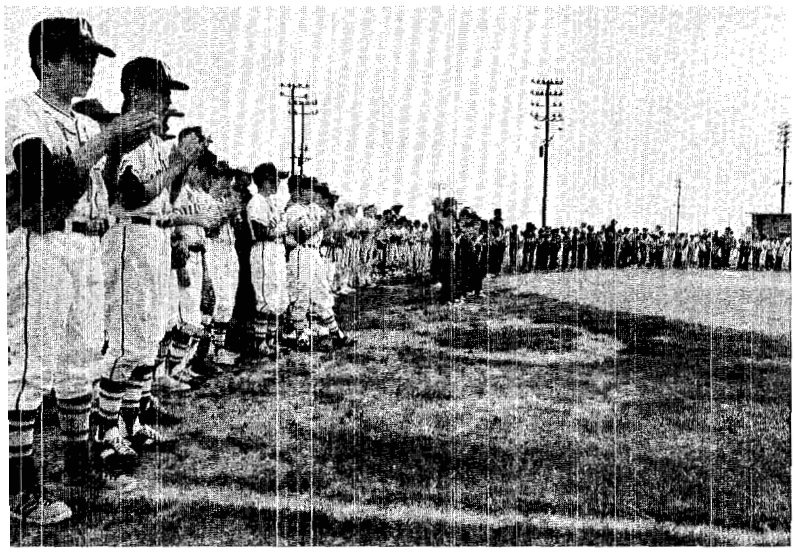
The provisional agenda, prepared in consultation with the United Nations Scientific Advisory Committee and with the cooperation of the International Atomic Energy Agency includes six main topics: nuclear power and special applications; nuclear fuels, cycles and materials; health, safety and legal aspects of nuclear energy; applications of isotopes and radiation; international and administrative aspects of nuclear energy; and aspects of nuclear technology of particular interest for developing countries.

Mench, Vigil and Martinez look over the finished product. The exposed model is of Scyllac as it will appear when completed. Lighted panels give information about Scyllac.



Play Ball!

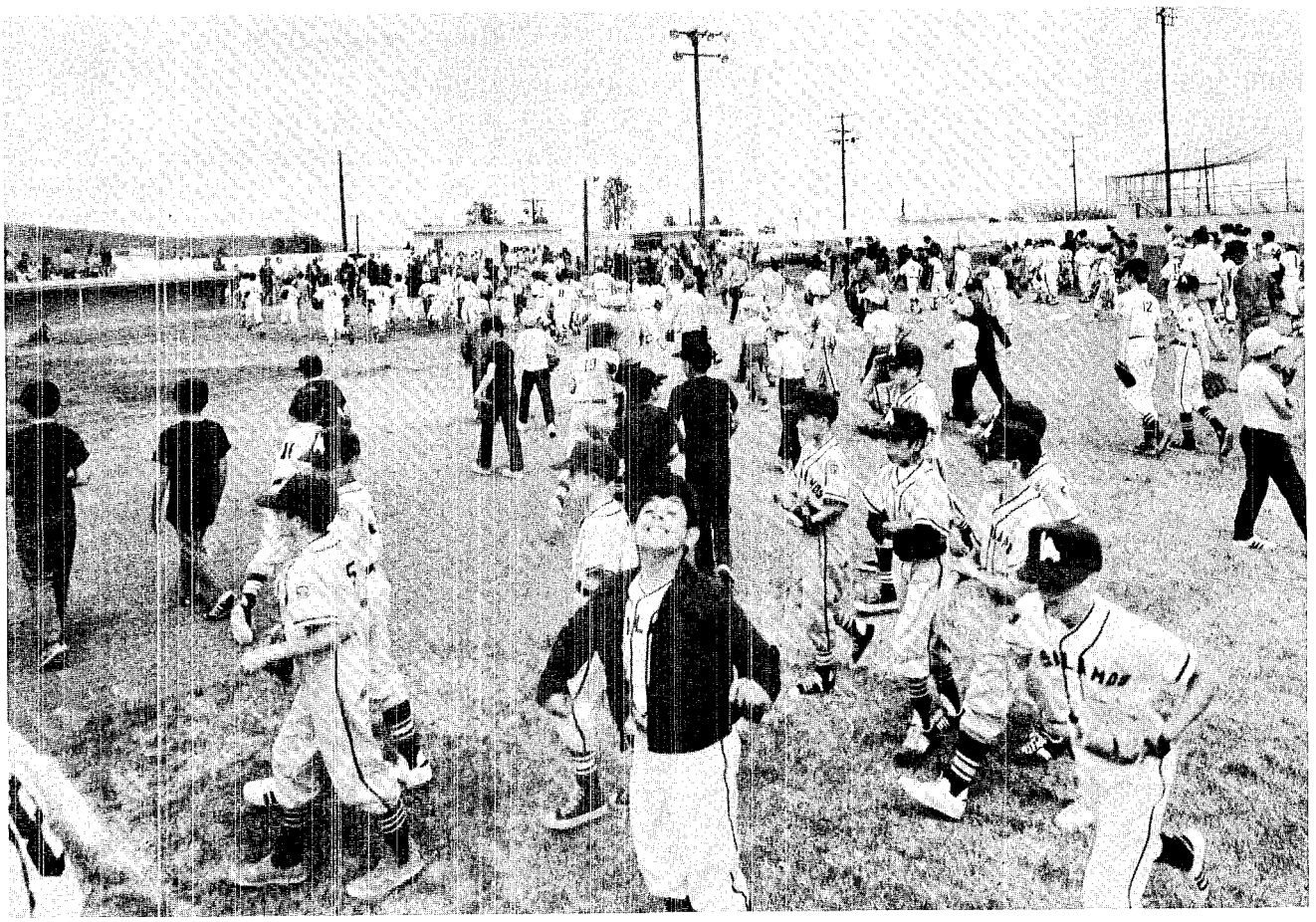
Below, Little Leaguers line the outfield in pre-game ceremonies. Bottom, team captains and managers talk with Umpire A. S. Kirby. To Kirby's left are Casa Luna Captain Brad Gibbons and Manager Lou Caveglia for whom the playing field is named. To the umpire's right are Dick Hemphill, manager of the Max Chevron-White Rock Tasty Freeze team, and Russ Mortensen, captain.



Little League baseball started this year with the first ball put in play by LASL's southpaw director, Harold Agnew. Behind Agnew is the Rev. Parker Anspach, District League Representative Ed Williams who received an award on behalf of Don Silver who has been making emblems for the caps of Los Alamos Little Leaguers since 1954, and Duane Chaffee, Little League president.

Agnew watches the first game with a Coke and a hot dog.

Little Leaguers leave the field after pre-game ceremonies.



Caveglia extends his hand to Gibbons who hit the first home run of the season.

The award for best of show at the Industrial Photographers of the Southwest Conference went to the Los Alamos Scientific Laboratory's J. M. "Mitzie" Ulibarri, ISD-7, for his photograph of the Cockcroft-Walton accelerator at LASL's Meson Physics Facility. At right is Billy Claybrook, ISD-7, conference chairman and new president of the IPSW. ISD-7 photographers took 10 of the 16 awards at the conference meeting. In color prints on the job, Bill Jack Rodgers was third; black and white on the job, Ulibarri, first; color off the job, Ivan Worthington, second; black and white off the job, Henry Ortega, first, Worthington, second, and Rodgers, third; color or black and white technical achievement, Eugene Lamkin, first, and Worthington, second. Robert Gordon, ISD-7, editor of the IPSW's publication "The Wide Angle," won first place in the Professional Photographers of America's competition for writing and Claybrook received the PPA's national award for contributions to photography. Other newly elected officers include Worthington who was elected second vice president. Gordon, Rodgers, Ortega and Ulibarri were elected to the board of directors.

short subjects

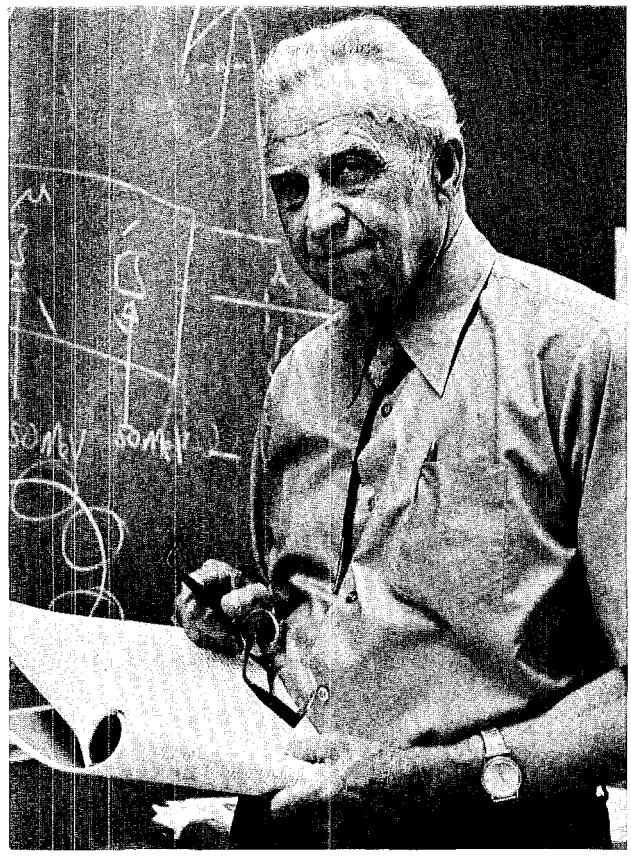
Darrell Davidson, J-8, died at the Los Alamos Medical Center following a short illness. He is survived by two children, Kenneth and Deborah.

Percy Myers, ENG-1, died at an Albuquerque hospital following a short illness. He is survived by his wife, Genevieve.

Raemer Schreiber, LASL's technical associate director, has accepted the invitation to serve on the National Aeronautics and Space Administration's Research and Technology Advisory Committee on Space Propulsion and Power. He will serve a term ending June 30, 1972.

The committee is one of eight formed by NASA's Research and Technology Advisory Council. It will aid the council in its function of advising the deputy administrator of NASA and the associate administrator for Advanced Research and Technology on research and technology aspects of aeronautics and space.

"Origin and History of LAMPF" being written by M. S. Livingston



M. Stanley Livingston, at work on the "Origin and History of LAMPF."

"Origin and History of the Los Alamos Meson Physics Facility," a Laboratory report, is being written by M. Stanley Livingston, author and internationally recognized designer of high-energy accelerators.

Livingston began working on the report in August, shortly after retiring from the National Accelerator Laboratory in Chicago where he was associate director. Following his retirement, Livingston and his wife moved to Santa Fe. He now spends a day each week at LAMPF compiling information for the report.

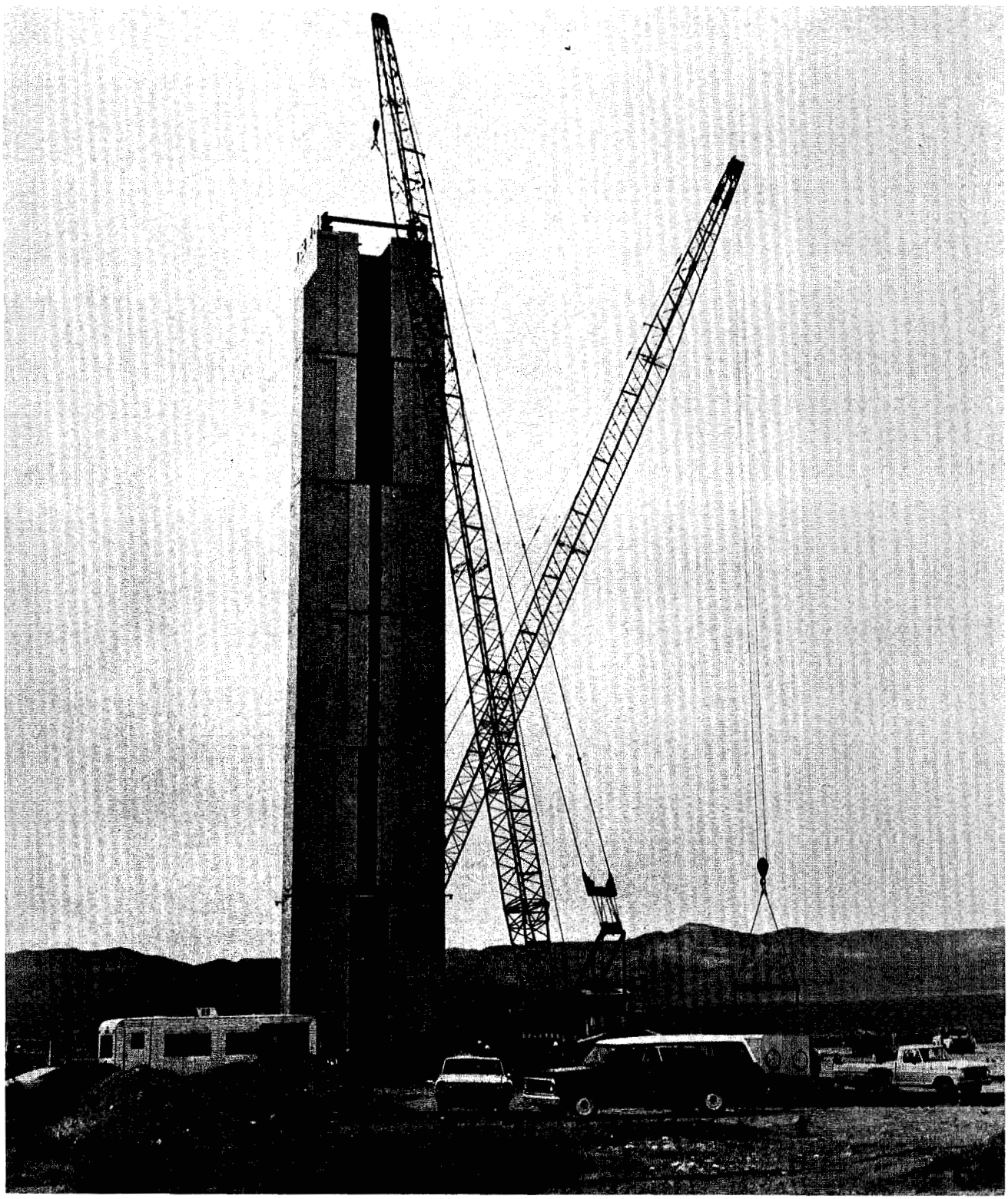
"It will be a series of stories about the machine, how it grew from the ideas of people and who these people were," said Livingston. "It won't be too technical a report."

Tentatively, seven chapters are planned and will include information about the competition among institutions for a meson accelerator facility, history of the Los Alamos project and the people involved, funding, technical development, the proposed biomedical facility, history of the Users Group and the facility's organization and administration.

Livingston has been instrumental in the design of many high-energy accelerators. At Berkeley, he and Ernest O. Lawrence built the first cyclotron to exceed one million electron volts. He was also instrumental in the design of the first proton synchrotron, called the Cosmotron. This was the first accelerator to reach the billion electron volt mark.

Livingston has also authored five books on high-energy accelerators, including a college text. "This is my first experience with a linac (linear accelerator)," he said. "All the other machines I have worked on were circular. One of the fellows here told me I've been going around in circles all my life, but now I'm straightened out."

Huge cranes are used to stack modules of LASL's new mobile service tower. (AEC photo)



155-Foot Service Tower Moves on Wheels

A new mobile service tower has been constructed at the Nevada Test Site for servicing equipment racks used in underground nuclear tests conducted by the Los Alamos Scientific Laboratory.

The equipment racks hold the nuclear device and some diagnostic equipment. Some of them are more than 100 feet long. The advantage of using a tower-type structure to service racks of such length is that it is more efficient to work with a single unit than with several sections. The tower's mobility allows servicing to take place in the area where the rack will be used, rather than to transport it over long distances after it has been readied for a test.

The structure was designed to J-6 specifications by Holmes and Narver, Inc., and built by Pyramid Derrick and Equipment Corporation of Houston, Texas.

It consists of stacked modules so it can be assembled and disassembled easily with the use of a crane and its height can be varied depending on the length of a rack. At least two of the modules—the top and the bottom—must be used. The top module has the roof and the supporting structures from which a rack is suspended. The bottom module is mounted on wheels which allow the tower to move on tracks. It is also equipped to provide heat or air conditioning to the rest of the tower to protect workmen from the elements.

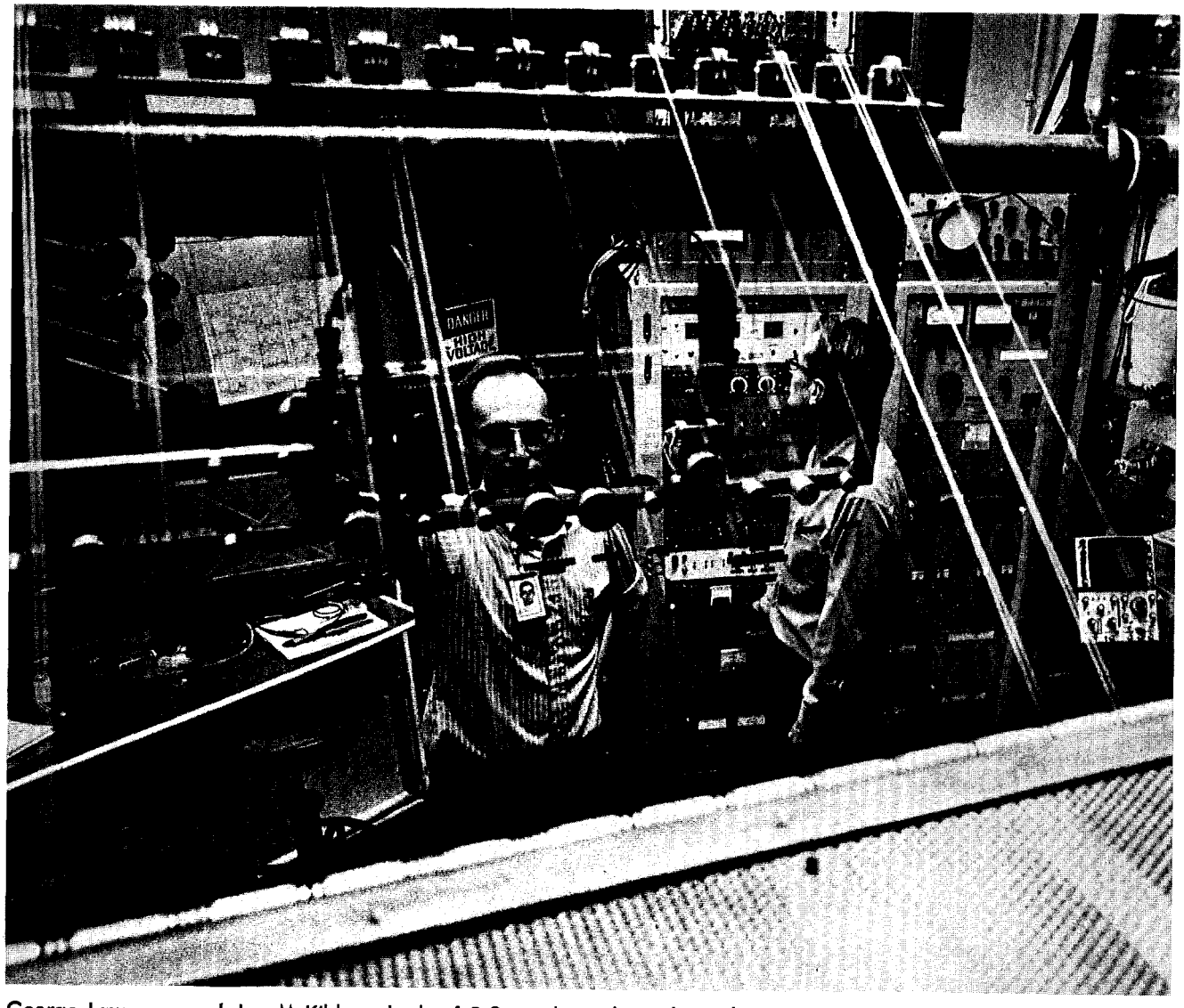
Use of the top and bottom modules provides a tower 55 feet high. Four other modules, each of which is 25 feet high, can be used to give the tower additional height up to 155 feet.

Each module has sliding doors, a staircase and a work platform. The sliding doors on each module are aligned so when all of them are open a portion of the tower's front face is open from top to bottom. This is for insertion and retrieval of an equipment rack. The staircase and work platforms provide workmen with access to any part of the rack.

There is also an outside service elevator on which equipment can be raised to the various work platforms.

In preparation for an underground event, the tower is mounted on tracks in the area where the rack will be used. After the rack has been serviced a crane is used to relieve tower support structures of the rack's weight and it is separated from the tower. There are two methods by which separation can be achieved. One way is to open the sliding doors and then push or pull the tower a short distance away where it can be dismantled without interfering with other preparations near the test hole. The other method, and the more popular one, is to have the crane lower the rack into the test hole while it is still inside the tower. After the rack has been lowered into the hole the tower can be moved away.

The Laboratory now has two mobile towers in use. The other was built for J-6 about two years ago by Reynolds Electrical and Engineering Company, Inc. It too consists of stacked modules. These are left over from the days of atmospheric testing which terminated in 1962. It is not air conditioned to protect workmen against the hot Nevada summer climate and its maximum height is only 125 feet. Also, it does not have a service elevator, although plans are to install one soon.



George Lawrence and Joe McKibben, both of P-9, work at the polarized-ion source's control panels. The vertical wires in the foreground are control lines for the machine's electronics.

Putting a Little "English" on Particles

By putting some "english" on the cue ball, skilled billiard players leave little to chance. They hit the cue ball either to the left or right of center, causing the ball to spin and develop a preference in the direction it will deflect off a cushion.

To gain a better understanding of nuclear forces and their dependence on the spin of particles, scientists have been doing something similar. In the past few years they have been placing more emphasis on controlling the spin direction of accelerated particles.

Normally, a collection of particles has randomly oriented spins. By controlling the direction in which they spin, scientists are influencing the

angles at which particles scatter after striking a target material. Having fewer scattering angles to contend with, the researchers expect to come closer to understanding the natural laws that govern nuclear forces when nuclei come together and interact.

Although it might be said that scientists are putting a little "english" on particles, they call it "polarization." Generally the term refers to a beam of literally millions of ionized particles (ions) which are all spinning in the same direction and with the same pole up. Like the needle of a compass, each one has a north and south pole.

Several machines have been built that will emit a beam of polarized particles. One of the most recent and advanced of these polarized-ion sources is being used at the Los Alamos Scientific Laboratory's Tandem Van de Graaff facility. Its developers are Joe McKibben and George Lawrence, both of P-9, and Gerald Ohlsen of P-DOR.

The machine is used to generate negatively charged, polarized hydrogen and deuterium ions. The negative charge is required because of the characteristics of the Tandem Van de Graaff accelerator. The ion source could also be used to produce negatively charged tritium ions although they are not considered to be practical at this time because of radioactive contamination problems that would accompany their use.

Polarized-ion production is achieved by first stripping the electrons from ground-state hydrogen or deuterium atoms. This leaves their nuclei. These nuclei are passed through a curtain of cesium vapor where most of them capture an electron. Those that don't are swept out by an electric field. The capture of an electron converts the nuclei into metastable atoms (excited atoms with an unusually long lifetime). The metastable atoms enter the ion-source's "nuclear spin filter" which permits the passage of only those with the desired polarization. Others are caused to decay to their ground state. The polarized, metastable atoms then pass through a cell filled with argon gas where they take on another electron. This converts them to ions with the negative charge required for acceleration through the Tandem Van de Graaff.

McKibben and Lawrence started working on the ion source in 1965. They were later joined by Ohlsen who was instrumental in the development of the nuclear spin filter.

"Where you have a metastable beam you also have a ground state beam accompanying it," McKibben said. "Actually, ground state atoms are much more abundant than the metastable. We needed a reaction that would make negatively charged ions from those that were metastable and that would preferably ignore the ground state. Argon is particularly selective in that considerable energy is required to take an electron away from it. Metastable hydrogen atoms already have about ten volts of energy above the ground state which have a minimum of energy and aren't likely to take electrons away from argon. This is how we eliminate some of the ground state particles."

"Our apparatus has the highest value of polarization among sources of its type and output current is nearly half a micro-ampere (three billion particles per second). It's also a very reliable machine. We

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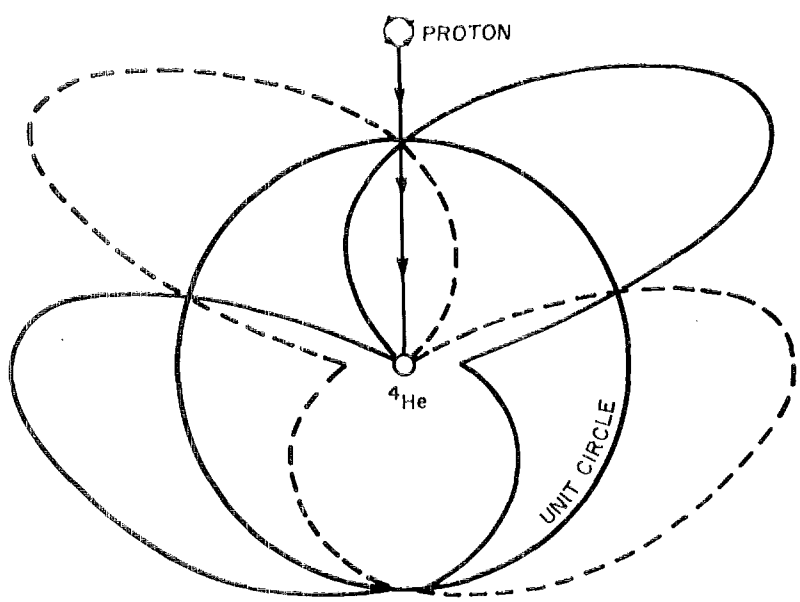


This illustration, prepared by McKibben, shows the distribution of polarized hydrogen ions (protons) scattered by a target of Helium-4. The solid line shows the intensity of scattering when the protons are spinning in the direction indicated. The dotted line is an inversion of the solid line to show how the hydrogen ions would scatter if they were spinning in the opposite direction. Distance away from the unit circle at any point on the lines indicates effect of polarization upon the angular intensity of scattering.

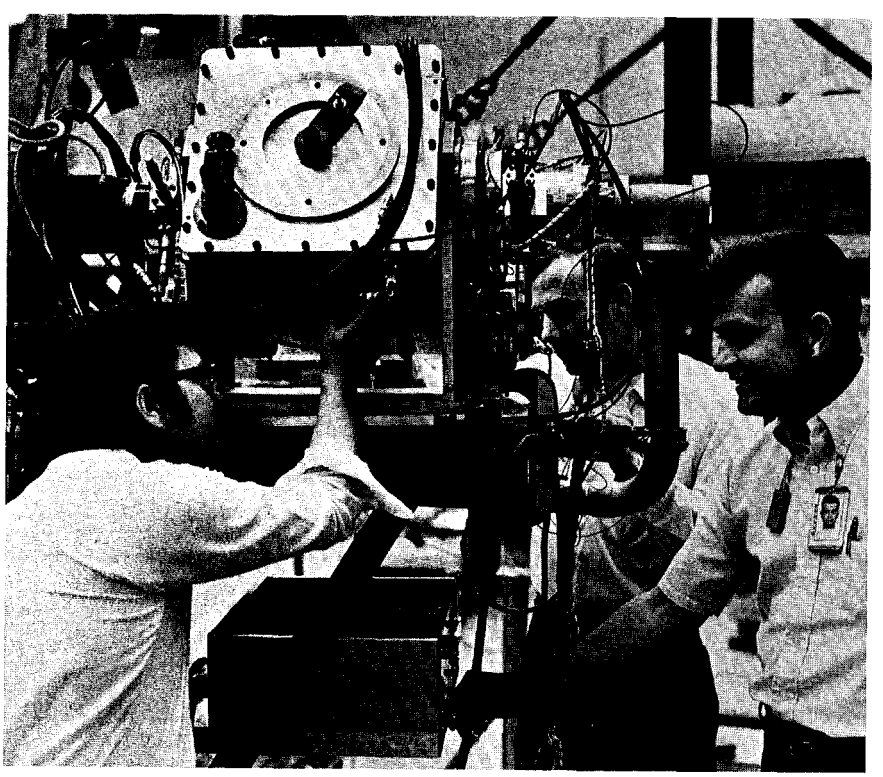
McKibben built this battery-powered spherical model for use during lectures and demonstrations to show the characteristics of polarized particles.

can run many shifts in sequence with only occasional attention to it."

Because of the excellent performance of the ion source many sophisticated experiments are in progress which were not previously possible. "We've been doing scattering experiments here for a long time, but the nature of nuclear forces is extremely complicated, McKibben said. "If we fully understood them there would be no reason for nuclear physics experiments. By working with polarized ions we think we can better untangle the puzzles of nuclear forces. When we have ions spinning in the same direction rather than a mixture, we can cut down on the scattering angle possibilities. It's primarily by looking at the assymetry of scattering, either to the right or to the left, that we're learning about nuclear forces as a function of alignment or misalignment of ions. It's not equal to both sides; it's unbalanced."

The LASL polarized-ion source has now been in use for about one and a half years. During this time it has logged nearly 2,000 hours of running time. "We've met the goals we set out to meet,' McKibben said. "The ion source is performing very well, although we keep improving it as we go along."

Gerald Ohlsen and P. W. Keaton, both of P-DOR, and Dale Armstrong of P-12, make adjustments on the Tandem Van de Graaff scattering chamber where counters observe the distribution of particles scattered by target materials.



the technical side

Taken from LASL Technical Information Reports submitted through ISD-6

Jaffe Institute, Leningrad, Russia, February 17; Technische Universitat, Munich, Germany, March 9; Saclay, France, March 26:

"Experimental Studies in Nuclear Pairing" by E. R. Flynn, P-DOR

Colloquium, National Bureau of Standards, Boulder, Colo., March 12:

"Resistance Thermometry with Thin Superconducting Aluminum Films" by D. H. Liebenberg, P-8 (invited)

Meeting on Anomalous Absorption of Intense High Frequency Waves, Princeton Plasma Physics Laboratory, Princeton University, N.J., March 18; and Physics Department Seminar, Massachusetts Institute of Technology, Cambridge, March 24:

"Anomalous AC Plasma Resistivity for Large Amplitude Electric Fields Near the Electron Plasma Frequency" by H. Dreicer, P-13

American Chemical Society's 161st National Meeting, Division of Nuclear Chemistry and Technology, Los Angeles, Calif., March 28-April 2:

"Preparation of Spherical, Single-Phase TaC Powder" by M. C. Tinkle, CMB-8, and D. E. Hull, CMB-7

"Preparation of U-Nb Alloys by the Bomb Method" by M. C. Tinkle, CMB-8

Fission Products and Nuclear Systematics Research Workshop, Advanced Research Projects Agency, Arlington, Va., April 1:

"Neutron Cross-Section Studies" by D. W. Barr, CNC-11

"Planned Program to Measure Direct Fission Yield of Xe Nuclides" by G. P. Ford and K. Wolfsberg, both CNC-11

Symposium on "Radiobiology, Past and Present," Argonne National Laboratory, Argonne, Ill., April 2:

"Research, Past and Present, on Biological Effects of Point Source Radiation Exposure" by W. H. Langham, H-4 (invited)

Science Writers Seminar, American Cancer Society, Carefree, Ariz., April 3-5:

" 'Heavy' Mice" by D. G. Ott, H-4 (invited)

"Automated Cell Analysis in Cancer Prescreening" by M. J. Fulwyler, H-4 (invited)

Indiana Study Group Meeting, Bloomington, Ind., April 5-7:

"Fission Isomers" by H. C. Britt, P-DOR (invited)

Spring Meeting, Optical Society of America, Tucson, Ariz., April 5-8:

"Time-Resolved, High-Resolution Absorption Spectra of UI and UII obtained by Flash Photolysis" by L. J. Radziemski, Jr., and D. W. Steinhaus, both CMB-1, and R. Engleman, Jr., GMX-2

Colloquium, National Accelerator Laboratory, Batavia, Ill., April 6:

"The Aim of Controlled Fusion" by J. L. Tuck, P-DO

American Mathematical Society Meeting, New York, N.Y., April 7-10:

"A Generating Operator for Solutions of Certain Partial Difference and Differential Equations" by Joan R. Hundhausen, C-6

American Geophysical Union's 52nd Annual Meeting, Washington, D.C., April 12-16:

"Helium-Rich Collisionless Shocks in the Solar Wind" by D. W. Forslund, P-18, and G. Beeler, Jr., J-10

"Preliminary Results of Fall 1970 Conjugate Auroral Flights" by R. W. Peterson and N. W. Glass, both J-16, and E. M. Wescott and H. C. S. Nielson, Geophysical Institute, College, Alaska

"Leakage of Plasma from the Magnetotail Into the Magnetosheath During Magnetospheric Substorms" by S. I. Akasofu, University of Alaska, College, E. W. Hones, Jr., S. J. Bame, M. D. Montgomery and S. Singer, all P-4

"Directed Fluxes of Monoenergetic Positive Ions in the High Latitude Magnetotail During Geomagnetic Storms" by S. J. Bame, M. D. Montgomery, E. W. Hones, Jr., and J. R. Asbridge, all P-4, and S. I. Akasofu, University of Alaska, College

"Solar Wind Electrons—Average Properties" by M. D. Montgomery, S. J. Bame and J. R. Asbridge, all P-4

"Interplanetary Shock Waves and Solar Flares" by A. J. Hundhausen, T-12 (invited)

Federation of American Societies for Experimental Biology, 55th Annual Meeting, Chicago, Ill., April 12-17:

"Heparan Sulfate of the Cell Surface: Relation to Mitotic Cycle Regulation" by P. M. Kraemer, H-4

International Magnetics Conference, Institute of Electrical and Electronic Engineers, Denver, Colo., April 13-16:

"Storage Requirements for Large-Scale Scientific Calculations" by W. J. Worlton, C-DO

Colloquium, University of California, Santa Barbara, April 13:

"Recent Progress in the Development of the Los Alamos Meson Physics Facility and the Emerging Experimental Program" by D. E. Nagle, MP-DO (invited)

American Nuclear Society Topical 1971 Meeting on Fast Reactor Fuel Element Technology, New Orleans, La., April 13-15:

"Thermal and Fast Irradiation of Sodium-Bonded Uranium, Plutonium Monocarbide Fuel and Fuel

continued on next page

Elements" by J. C. Clifford and J. O. Barner, both CMB-11, and R. L. Cubitt and D. C. Kirkpatrick, both Division of Compliance, AEC, Atlanta, Ga.

Rocky Flats Symposium on Plutonium Handling Facilities, The Dow Chemical Company, Rocky Flats Division, Golden, Colo., April 13-16:

"Respirator Performance Using Quantitative Man Tests" by E. C. Hyatt, J. A. Pritchard and C. P. Richards, all H-5

"Processing of Plutonium-Contaminated Liquid Wastes at Los Alamos" by L. A. Emelity and C. W. Christenson, both H-7

"An Approach to Plutonium Surface Contamination Levels" by J. W. Healy, H-DO

Second Society of Photo-Optical Instrument Engineers Seminar in Depth on Holography, Boston, Mass., April 14-15:

"Three-Frame Pulsed Holographic Interferometry of a Helical Plasma" by R. E. Siemon and F. C. Jahoda, both P-15

American Nuclear Society National Topical Meeting on Neutron Sources and Applications, Augusta, Ga., April 18-21:

"Yttrium-88—A New Replacement for Antimony-124 in a Nuclear Materials Assay System" by L. A. Kull and J. R. Beyster, J. R. Beyster Associates, LaJolla, Calif. and M. E. Schillaci, MP-7

"Isotopic Neutron Sources from the Los Alamos Meson Physics Facility" by H. A. O'Brien, Jr., MP-DO, and M. E. Schillaci, MP-7

"Mobile Accelerator Facility for Neutron Interrogation and Nondestructive Assay" by B. R. Dennis, ENG-6, and R. A. Forster, J. H. Menzel, M. M. Thorpe, and D. B. Smith, all A-1

"Nuclear Safeguards and Materials Management" by H. O. Menlove, A-1

"The Unique Research Potential of Neutron Pulses from Nuclear Explosions" by R. L. Carter, formerly W-8

"Using a Meson Factory as an Intense Pulsed Neutron Source" by R. R. Fullwood, W-8

"Moderator Investigation of ^{252}Cf for Nondestructive Assay of Fissionable Materials" by R. A. Forster and H. O. Menlove, both A-1

Nuclear Structure Research Laboratory, University of Rochester, N.Y., April 19-23:

"Theory of Nuclear Fission and Superheavy Nuclei" by J. R. Nix, T-9

Seminar, University of Texas, Dallas, April 20:

"Ultralow Temperatures-Applications to Quantum Solids and Fundamental Symmetries" by J. R. Sites, P-8

Fourth Symposium on Engineering Problems of Fusion Research, Washington, D.C., April 20-23:

"Analysis of Component Failure Problems Using Partially Ordered Sets" by G. P. Boicourt, P-16

"Fast High-Energy Switch Development for Plasma Focus Research" by J. P. Carpenter, A. H. Williams, K. D. Ware, P. J. Bottoms and J. W. Mather, all P-7

"The Linear Feedback Stabilization System for Scyllac" by D. L. Call, P-16, R. F. Gribble and R. E. Siemon, both P-15

"Auxiliary Coil Systems for Scyllac" by W. H. Borkenhagen and H. W. Harris, both P-16, and W.

what's doing

OUTDOOR ASSOCIATION: No charge, open to the public. Contact leaders for information. (River trips*)
- June 5-6—Ute Mountain Run, Ken Chellis, 662-3836*
- June 12 or 13—Redondo Peak, Dave Brown, 662-2185
- June 12-13—Conejos River, Jon Cross, 662-7521*
- June 19-20—Upper San Juan, Walt Green, 662-3203 and Dave Blevins, 662-7458*
- June 26-27—Johnson Lake, Ken Ewing, 662-7488
- July 3-5—Humboldt Peak, Colo. (difficult), Ed Kmetko, 662-7911
- July 10-11—Mt. Adams, Colo. (difficult), Reed Elliott, 662-4515

MOUNTAIN MIXERS SQUARE DANCING CLUB: For information call Dee Seitz, 622-7356.
- June 5—Pinon Park, 8 p.m., Bones Craig, caller.
- June 19—Pinon Park, 8 p.m., J. D. Wilbanks, caller.
- July 3—Pinon Park, 8 p.m., Bud Garret, caller.
- July 17—Pinon Park, 8 p.m., Nelson Watkins, caller.

RIO GRANDE RIVER RUNNERS: Meetings scheduled for noon, second Friday of each month at South Mesa Cafeteria. For information call Joan Chellis, 662-3836.

LOS ALAMOS FILM SOCIETY: 7:30 p.m., June 30, Civic Auditorium. "Woman in the Dunes." Admission: members—$.50, others, $2.

NEWCOMERS CLUB: June 9, 11:30 a.m.—Picnic for mothers and children at Pinon Park, White Rock. Bring own food and service.

MESA PUBLIC LIBRARY:
- May 18-June 8—Enamel-on-copper bowls, Jay Todd
- May 19-June 8—Oils, Roger Blake
- May 20-June 7—Castings of pre-Columbian art, Tony Shearer
- June 9-July 6—Paintings, Joe Moody
- July 7-July 30—Water colors and oils, Roger Camillo

INTERNATIONAL FOLK DANCING: Every Tuesday, 8 p.m., Recreation Hall. For information contact Don Liska, 662-3665, or Roy Greiner, 672-9961.

SIERRA CLUB: Luncheon meeting at noon, first Tuesday of each month, South Mesa Cafeteria. For information call Brant Calkin, 455-2468, Santa Fe.

OLD TIMERS SQUARE DANCE CLUB: Second and fourth Saturday of each month, 8:30 p.m., YMCA. For information call Frances Hollinrake, 662-5898.

LOS ALAMOS ARTS AND CRAFTS ASSOCIATION: Summer classes starting sometime in June. Oil painting—Thursday afternoons and evenings. Pottery for children—Wednesday afternoons. For information call Betty Dougherty, 662-6062. (Other classes offered if interest warrents.)

PUBLIC SWIMMING: High School Pool—Monday through Friday, 1 to 6 p.m., and 7 to 10 p.m., Saturday and Sunday, 1 to 6 p.m.; Adult Swim Club, Sunday, 7 to 9 p.m. Children's summer recreation program, 9 a.m. to 1 p.m. weekdays, June 6 through July 16. (Two week sessions) For information call, 662-4106.

SANTA FE OPERA: Los Alamos ticket office opens June 21, Los Alamos Building and Loan, Monday, Wednesday and Friday, 10 a.m., to 1 p.m. For information call Sherron Kirkpatrick, 662-2734.
- July 9—"Don Carlo" (Opening Night)
- July 10—"The Magic Flute"
- July 16—"The Magic Flue"
- July 17—"Don Carlo"

R. Ellis and E. L. Zimmerman, both P-15

Seventh Annual Symposium, New Mexico Section, American Vacuum Society, Albuquerque, N.M., April 21:

"Vacuum and the Actinide Elements" by K. W. R. Johnson, CMB-11

"Segregation of Impurities on Surfaces of Thorium: Thermodynamics and Kinetics" by W. P. Ellis, CMB-8

Southwestern and Rocky Mountain Division, American Association for the Advancement of Science, Tempe, Ariz., April 21-24:

"The Enthalpy of Solution of Samarium Metal and the Enthalpy of Formation of Samarium Sesquioxide" by C. E. Holley, Jr., G. C. Fitzgibbon, both CNC-2, and L. D. Hansen and E. A. Lewis, both University of New Mexico, Albuquerque

"The Los Alamos Meson Physics Facility (LAMPF): An Open Research Facility with Potentialities in Nuclear and Particle Physics, Biology and Medicine, Nuclear Chemistry, and Radionuclide Production" by L. Agnew, MP-7, B. Dropesky, CNC-11, W. Langham, H-4, H. O'Brien and L. Rosen, both MP-DO

Meeting on Nuclear Scattering Potentials for Composite Projectiles, University of North Carolina, Chapel Hill, April 23-24:

"Spin-Orbit Potentials for Deuterium, Tritium, and Helium-3" by P. W. Keaton, Jr., P-DOR (invited)

American Association of Physics Teachers Meeting, West Texas State University, Canyon, April 24:

"Life at Los Alamos Scientific Laboratory—A Large Multipurpose National Facility" by N. Jarmie, P-DOR (invited)

American Ceramic Society 73rd Annual Meeting, Chicago, Ill., April 24-29:

"Compressive Creep and Hot Hardness of Uranium-Plutonium Carbide" by M. Tokar and J. A. Leary, both CMB-11

"Helium Bubble Formation in $^{238}PuO_2$" by R. N. R. Mulford and Barbara Mueller, both CMB-5

Third Annual Houston Conference on Computer and System Sciences, Houston, Texas, April 26-37:

"Further Results in Separable-Sum Approximations for Digital Filtering of Pictures" by B. R. Hunt, C-5

American Physical Society Meeting, Washington, D.C., April 26-29:

"The Triton (deuteron, neutron) Helium-4 Neutron Source Reaction" by D. K. McDaniels, M. Drosg, J. C. Hopkins, J. T. Martin and J. D. Seagrave, all P-DOR

"The Decay of 151-Neodymium to Levels of 15-Promethium" by H. A. Smith, J. W. Starner and M. E. Bunker, all P-2

"Excited Zero Plus States in Lead-210 (proton, triton) Lead-208 and Lead-206 (triton, proton) Lead-208 Spectra at 20 MeV Bombarding Energies" by G. J. Igo, University of California, Los Angeles, P. D. Barnes, Carnegie-Mellon University, Pittsburgh, Pa., and E. R. Flynn, P-DOR

"The $^{87}Sr(t, p)^{89}Sr$ Reaction and the Two-Particle, One-Hole States of ^{89}Sr" by D. C. Slater and E. R. Cosman, both Massachusetts Institute of Technology, Cambridge, O. Hansen and E. R. Flynn, both P-DOR

"Primary Solar Reaction Dependence on Deuteron Structure" by J. E. Brolley, P-DOR

"Supersonic Jet Target in Vacuo" by J. E. Brolley, P-DOR

"Accurate d-^{4}He Scattering Cross Sections at 12.0 MeV" by J. H. Jett, J. L. Detch, Jr., and N. Jarmie, all P-DOR

"Second-Order Coulomb Excitation in ^{72}Ge" by R. C. Haight, P-DOR

"Observation of an Emission Feature at 11.7cm^{-1}" by J. G. Beery, P-DOR, and T. Z. Martin, I. G. Holt, and C. W. Wood, all University of Hawaii, Honolulu

"Polarization Transfer in the T(p, n) ^{3}He Reaction at 0°" by J. E. Simmons, R. C. Haight, T. R. Donoghue, all P-DOR, and G. P. Lawrence, P-9

"Review of Plasma and MHD Simulation at Los Alamos" by B. M. Marder, P-18

"New Measurement of (π^+2p) Reaction on Light Nuclei" by J. Amato, R. Burman, R. Macek, all MP-7, W. Shlaer, MP-3, J. Oostens, MP-4, E. Arthur and S. Sobottka, University of Virginia, Charlottesville, W. Lam and P. Barnes, both Carnegie-Mellon University, Pittsburgh, Pa., P. Fessenden and W. Swensen, Oregon State University, Corvallis, D. Axen and M. Salomon, both University of British Columbia, Vancouver

"Experimental Study of the Tensor Component of the Effective Interaction in Iron-54(proton, neutron) Cobalt-54" by R. F. Bentley, J. D. Carlson, and C. D. Zafiratos, all University of Colorado, Boulder, and R. B. Perkins, P-DO

"Correction for Deviation from Poiseuille Flow in a Gas Viscometer" by F. A. Guevara, B. B. McInteer and W. E. Wageman, all CNC-4

"Calculation of Proton-Proton Bremsstrahlung" by L. Heller and M. Rich, both T-9

"Shapes of Neutron Rich Nuclei Near A-110 Studied with the (t, p) Reaction" by O. Hansen, E. R. Flynn, T. J. Mulligan and R. F. Casten, all P-DOR

"Search for (π^+p) Reaction of ^{16}O, ^{12}C, and ^9Be" by R. Macek, J. Amato, and R. Burman, all MP-7, W. Shlaer, MP-3, J. Oostens, MP-4, E. Arthur and S. Sobottka, University of Virginia, Charlottesville, and W. Lam, Carnegie-Mellon University, Pittsburgh, Pa.

"Decay of Vortex Tangles in Superfluid Helium" by L. J. Campbell, P-8

"Levels in ^{185}W and ^{187}W Excited in the (d, p) Reaction with Polarized Deuterons" by R. F. Casten and P. W. Keaton, Jr., both P-DOR, and G. P. Lawrence, P-9

"A Study of the Elastic Scattering of Polarized Deuterons from Nuclei" by D. D. Armstrong, P-12, P. W. Keaton, Jr., and L. L. Catlin, both P-DOR, and G. P. Lawrence, P-9

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20 years ago in los alamos

Culled from the June, 1951, files of the Los Alamos Herald by Robert Porton

Bike Riding Banned in Community Center

Hey, kids, there'll be no more riding your bikes down those nice long walkways in the Community Center. At least that's what the new traffic ordinance for Los Alamos County says. And you can't fool the County Commissioners. They know just what a bicycle is. Here's what they say about bicycles: "Every device propelled by human power upon which any person may ride, having two tandem wheels either of which is over 20 inches in diameter, and including any device generally recognized as a bicycle, even though having two rear wheels."

Private Home Ownership Under Study at Los Alamos

The community study panel of the Atomic Energy Commission is to be in Los Alamos next week. The panel was formed last summer to study the problems of introducing private ownership of real property and self-government in the three communities housing the people who work in the plants and laboratories at Los Alamos, Hanford, Wash., and Oak Ridge, Tenn. The group will advise the Commission on how far and by what means these steps can be taken without jeopardy to AEC operations. The panel members will confer with officials of Santa Fe Operations, Los Alamos Scientific Laboratory, the Zia Company and the county.

Cost of Living on Hill Climbs

The cost of living went up 5.3 per cent in Los Alamos during the past year. But, an AEC announcement pointed out, there was no increase in the average grocery bill during this time. The item which jumped the highest in price during the past 12 months was house furnishings. Cost of living items which remained unchanged during the year, in addition to food, were fuel, utilities and ice.

Air Raid Shelters Planned

Plans for scores of small air raid shelters for Los Alamos and other SFO facilities are in the works, and will be pushed to conclusion if Congress appropriates sufficient money for the task, it was learned this week. Lloyd C. Kersey, project officer of the Disaster and Defense Planning Committee, stated that the shelters would be scattered throughout the community so that no residence nor working area would be more than 500 feet from such a shelter. He said that a rough estimate of the cost of shelters in all SFO locations would be $3 million to $4 million. He did not mention a figure for Los Alamos.

"Quadratic Relations for Simple Spin Systems" by P. W. Keaton, Jr., and G. G. Ohlsen, both P-DOR, and J. L. Gammel, T-9

"Precise Proton and Deuteron Polarization Standards Determined with the LASL Lamb Shift Ion Source" by G. P. Lawrence and J. L. McKibben, both P-9, G. G. Ohlsen and P. W. Keaton, Jr., both P-DOR, and D. D. Armstrong, P-12

International Congress on Protection Against Accelerator and Space Radiation, CERN, Geneva, Switzerland, April 26-30:

"High Intensity Electron Accelerator Radiation Hazards" by J. R. Parker, MP-1, and M. J. Engelke, H-1

American Ceramic Society Meeting, Chicago, Ill., April 26-30:

"Material Properties and Penetration Mechanics" by J. W. Taylor, GMX-6 (invited)

Second International American Welding Society Brazing Conference, San Francisco, Calif., April 27-29:

"Hydrogen Furnace Brazing of LAMPF Accelerator Structures" by H. G. Worstell, MP-3 (invited)

Seminar, University of Notre Dame, Ind., April 28:

"Numerical Modeling of Incompressible Fluid Flows" by B. D. Nichols, T-3

Seminar, United Aircraft Research Laboratories, East Hartford, Conn., April 29:

"Plasma and MHD Simulation" by B. M. Marder, P-18

Fourth International Cell Cycle Conference, San Antonio, Texas, April 29-30:

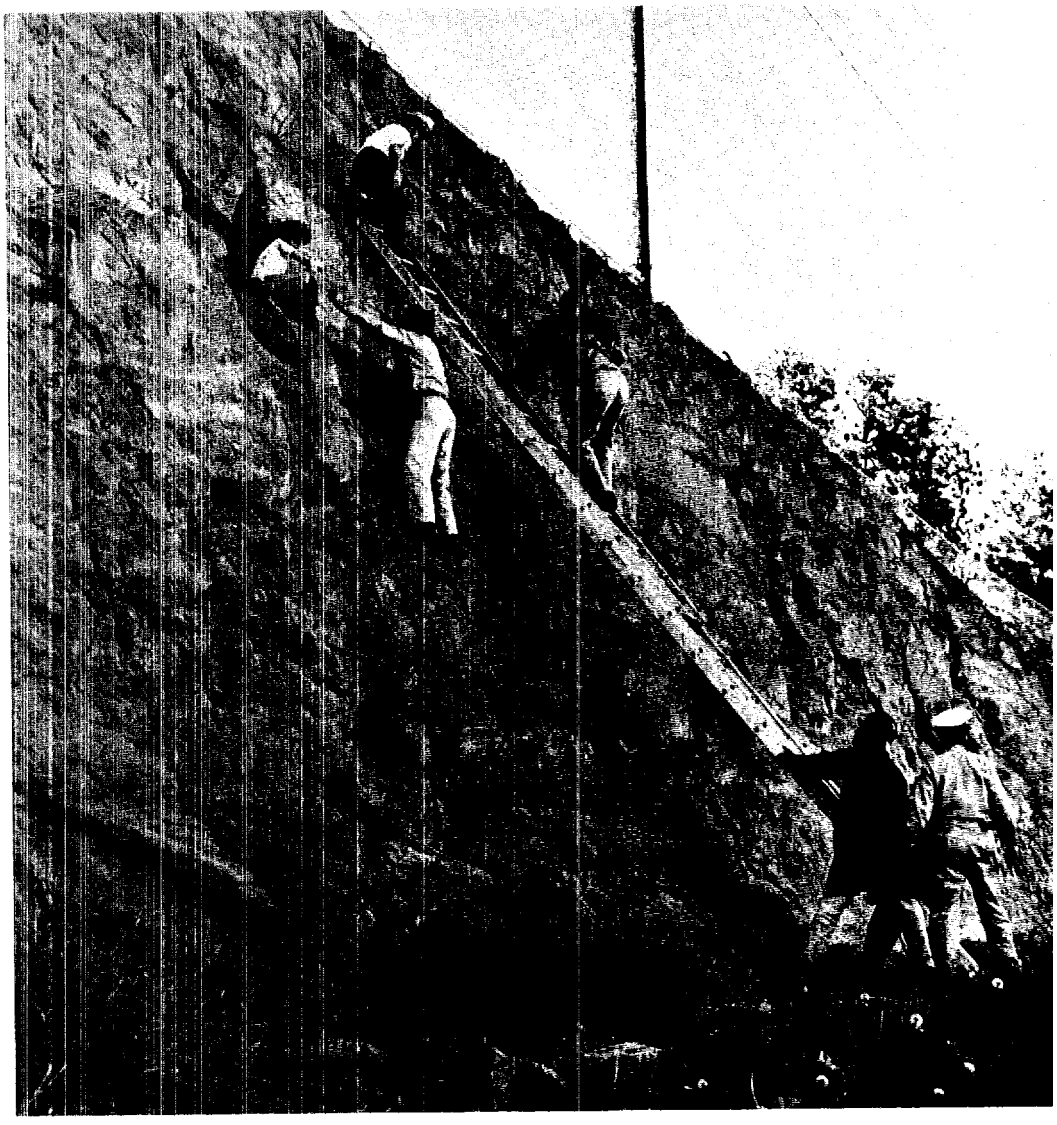
"Protein Inhibitors and the G_2 Phase" by D. F. Petersen, H-4 (invited)

Edgewood Arsenal, Md., April 30:

"Collective Excitations in Silicon-28" by D. K. McDaniels, P-DOR (invited)

Seminar, Florida State University, Tallahassee, April 30:

"LAMPF Experimental Area Facilities" by R. J. Macek, MP-7



Richie Ruiz and Jimmy Bowen tried scaling this cliff on Diamond Drive near Mountain School. After reaching a point where they could neither climb up or go back down, Los Alamos firemen went to their rescue. In this photo, taken by ISD-7 Photographer Bill Jack Rodgers, Jimmy is being brought down the ladder by a fireman. Another fireman extends a hand toward Richie.

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Putting an aluminum reflective sealer on the roof of LASL's Central Computing Facility looks to be a lonesome, if not a hot job on a summer day.